DLT/Blockchain Architectures and Reference Frameworks

A System-of-System Model

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BEC BLOCKCHAIN ENGINEERING COUNCIL

IEEE BLOCKCHAIN

2018 IEEE Global Blockchain Summit

IEEE

Disclaimer

This presentation expresses the view of the author only.

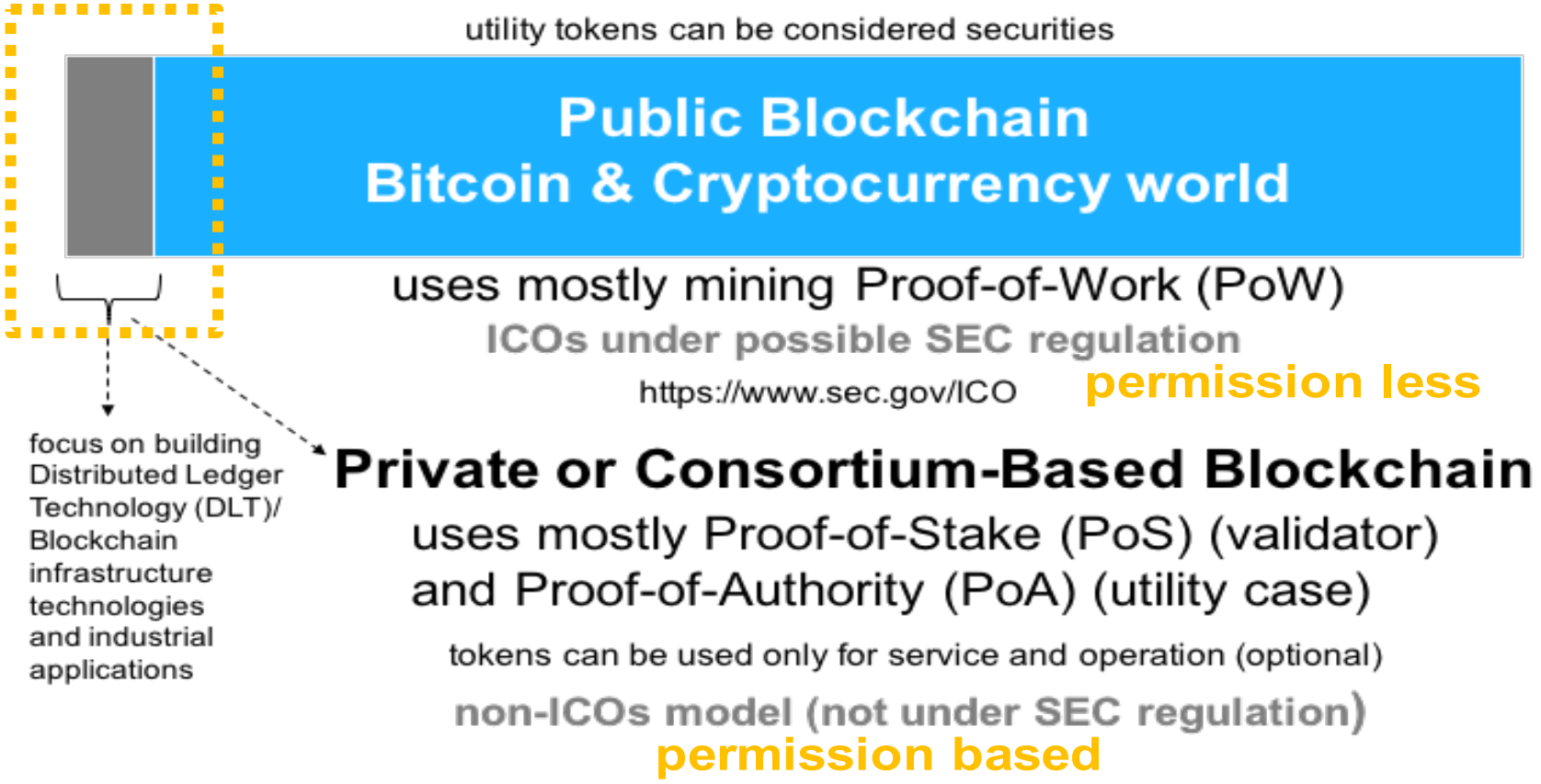
*It also presents some ongoing work (members contributions) being developed under the **IEEE Blockchain Standards**, which are neither a final nor an approved standard.*

Agenda

- **Demystifying Blockchain**
- **Evolution Towards Web 3.0 Decentralized Internet**
- **DLT/Blockchain Standards Goals**
- **Key Principles, Framework and Reference Architectures**
- **IEEE Special Projects Guideline**
- **DLT/Blockchain Interoperability Labs (DLT-i-Labs)**
- **Use Case: Blockchain in Energy**
  - *Open Blockchain Energy (OBE) Framework*
  - *Applications and Segmentation*
  - *Transactive Energy with Blockchain/DLT Reference*
  - *Wholesale/Retail Grid-Blockchain Model*
  - *P2P Energy Trading with Blockchain*
- **Key Takeaways**

Demystifying Blockchain

Blockchain is not Only Bitcoin or Cryptocurrency – It's more than that!



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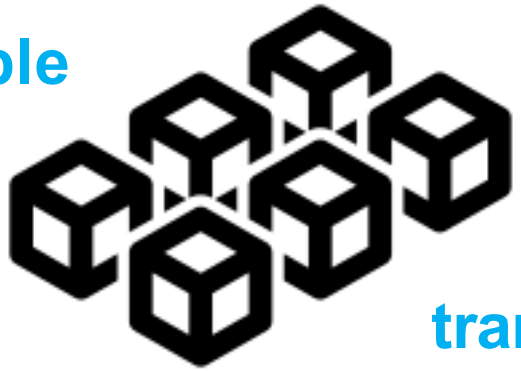
source: Blockchain Engineering Council, BEC

Demystifying Blockchain

What is the Value of Blockchain?

traceable

trustable



transparent

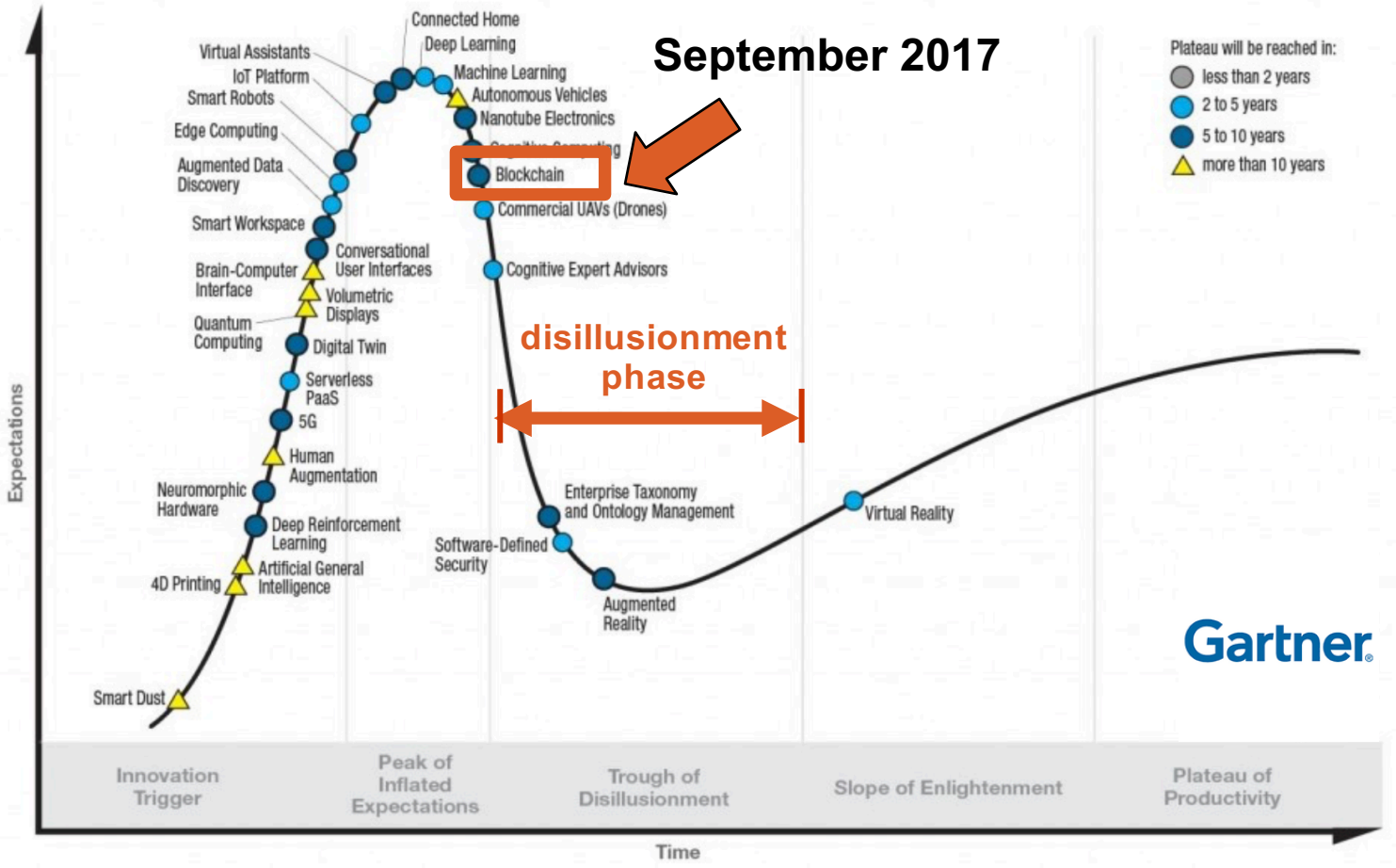
Blockchain Is The New Internet—The Trinity Of T's

"Blockchain is the Internet Control Layer"

- eliminate intermediaries
- immutable and tamper resistant transactions
- reduce costs of supply chains
- build trust
- uses transparency for all assets and data registry
- minimizes fraud
- secures data processing and information

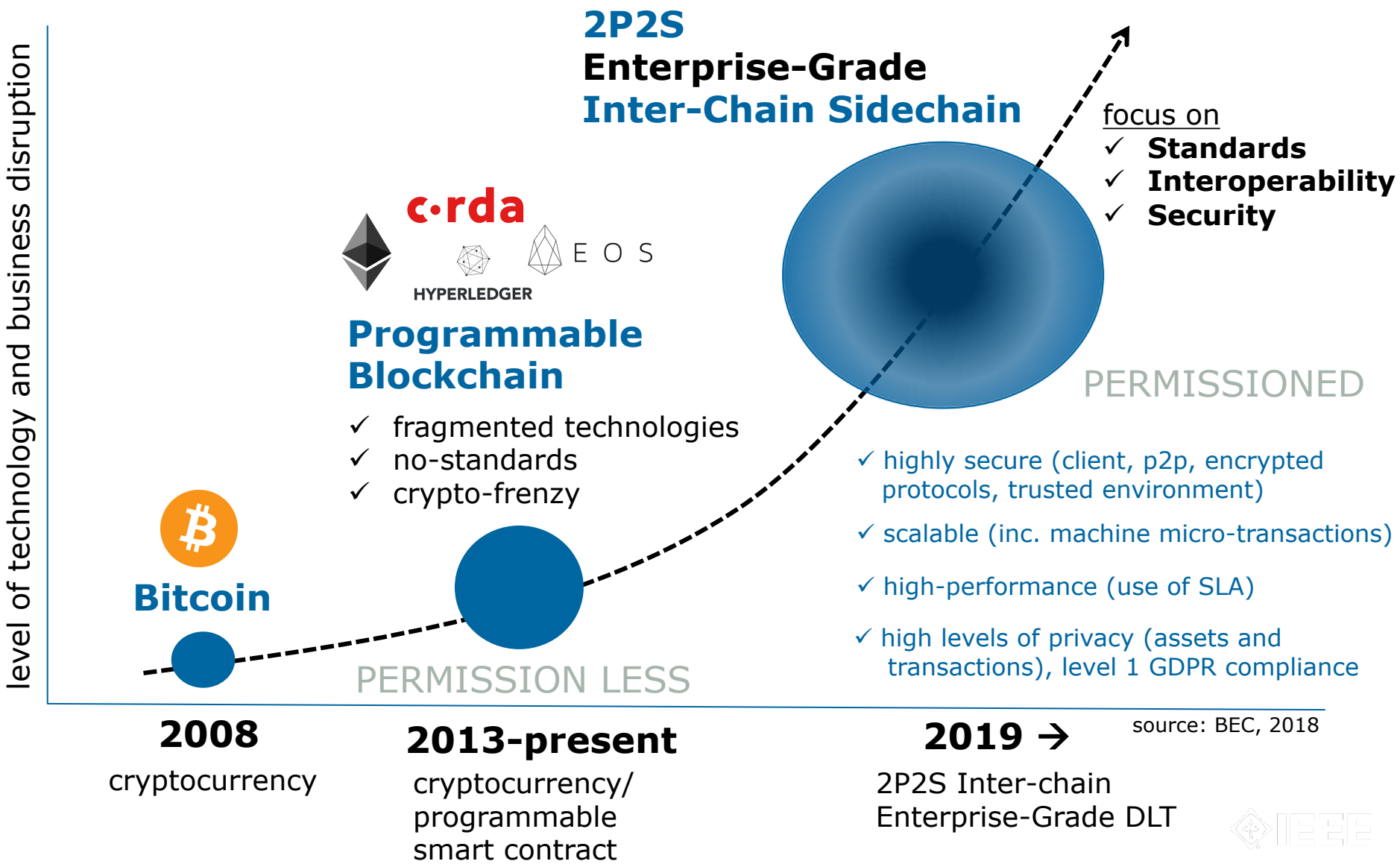
C. Lima, "Blockchain Is The New Internet—The Trinity Of Ts"
source: https://goo.gl/hq7ACy

Blockchain Innovation Hype Curve



Blockchain technology has passed the peak of inflated expectations (2Q17) and is now on its way down towards the phase of disillusionment.

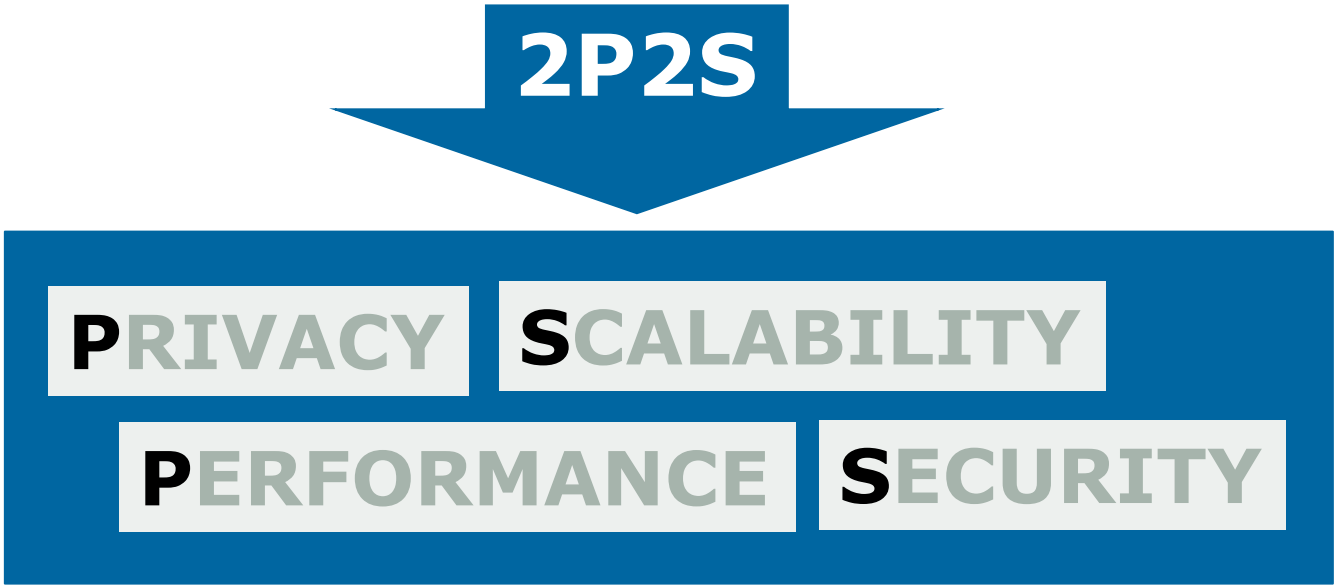
Towards a Secure, High Performance DLT/Blockchain Web 3.0 Internet



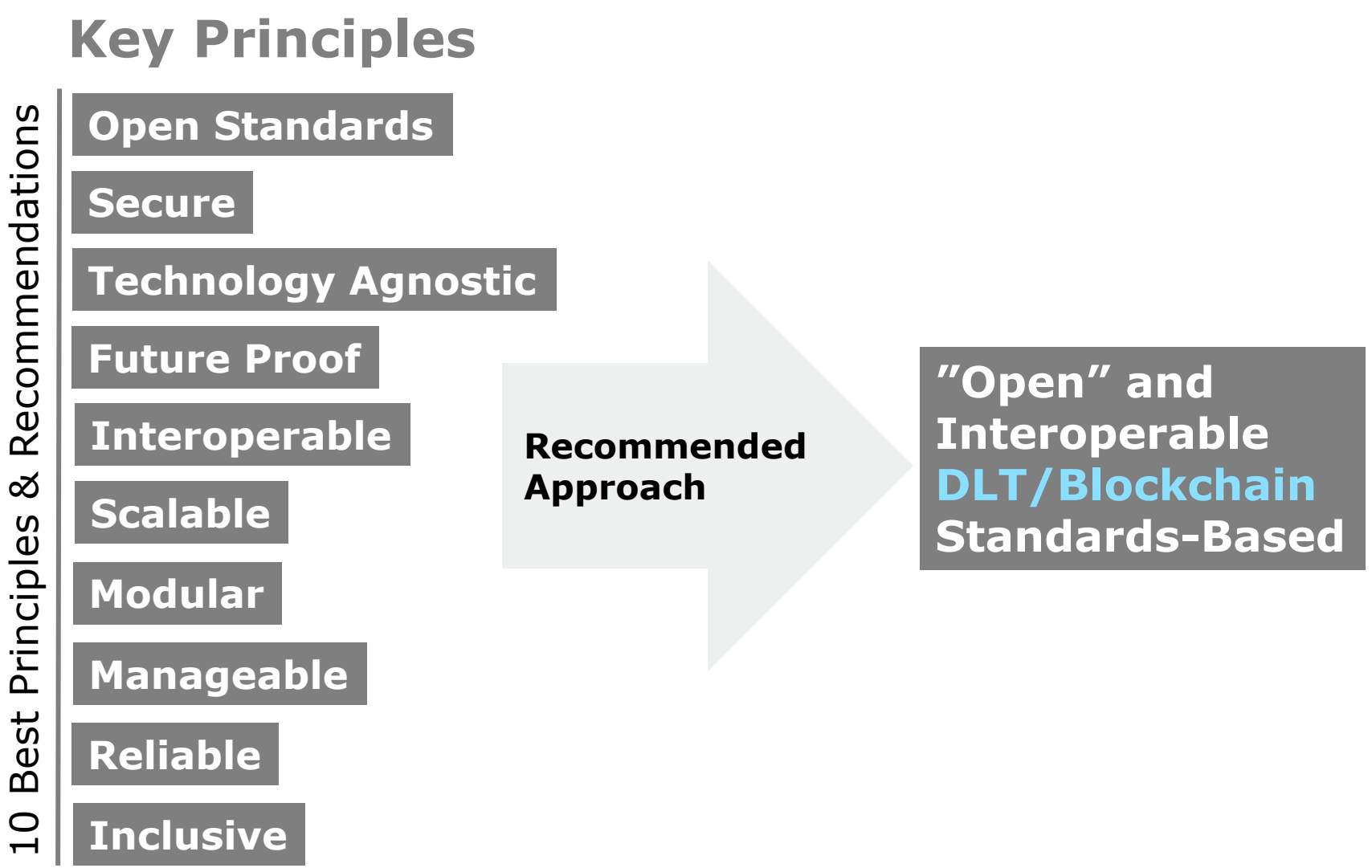
source: BEC, 2018

Goals for DLT/Blockchain Standards

To create the **IEEE Blockchain IoT, Energy and Other Verticals Reference Framework** using a System-of-System Systemic Engineering Approach



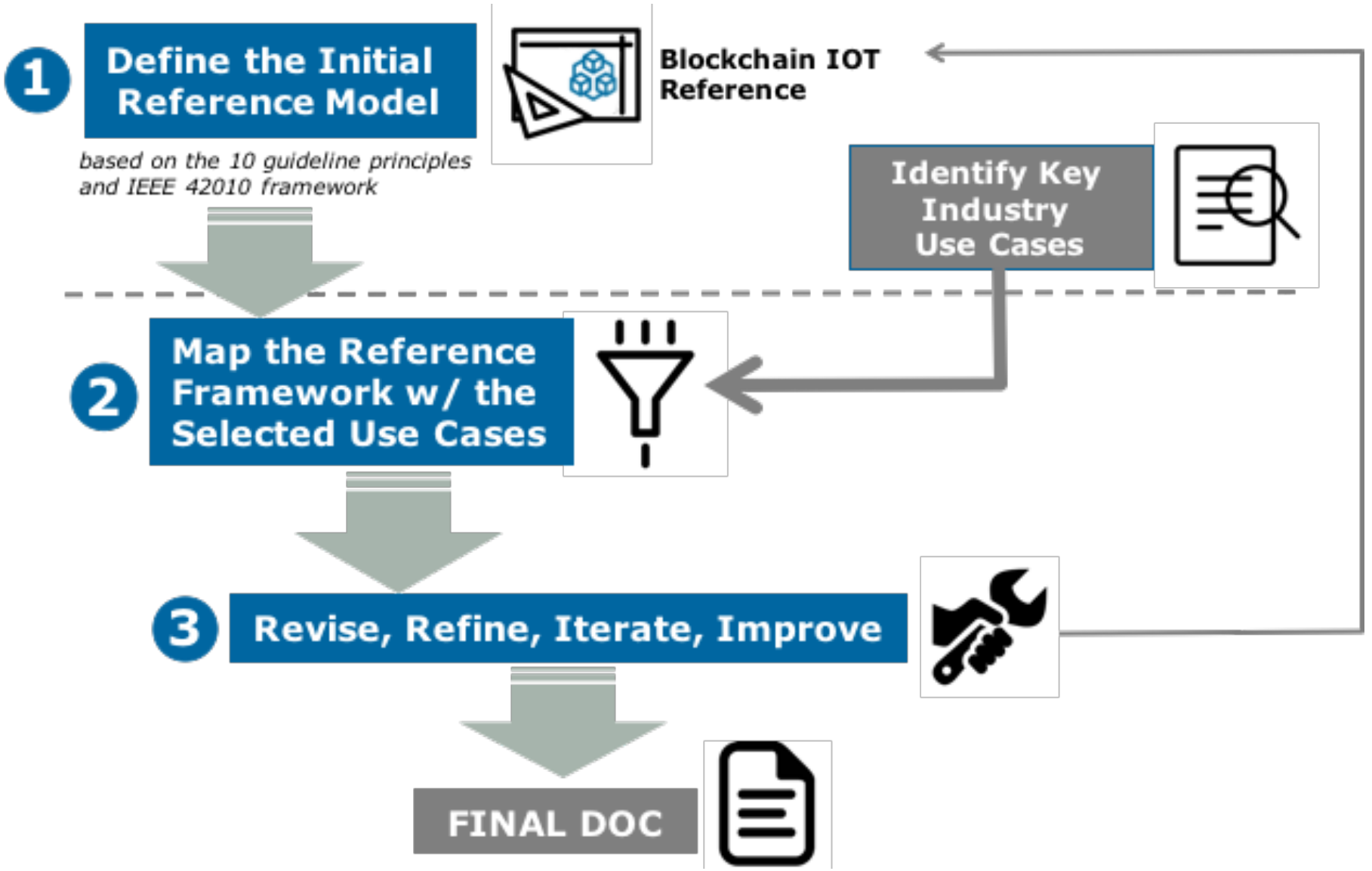
Blockchain IoT Reference Framework



Key Attributes

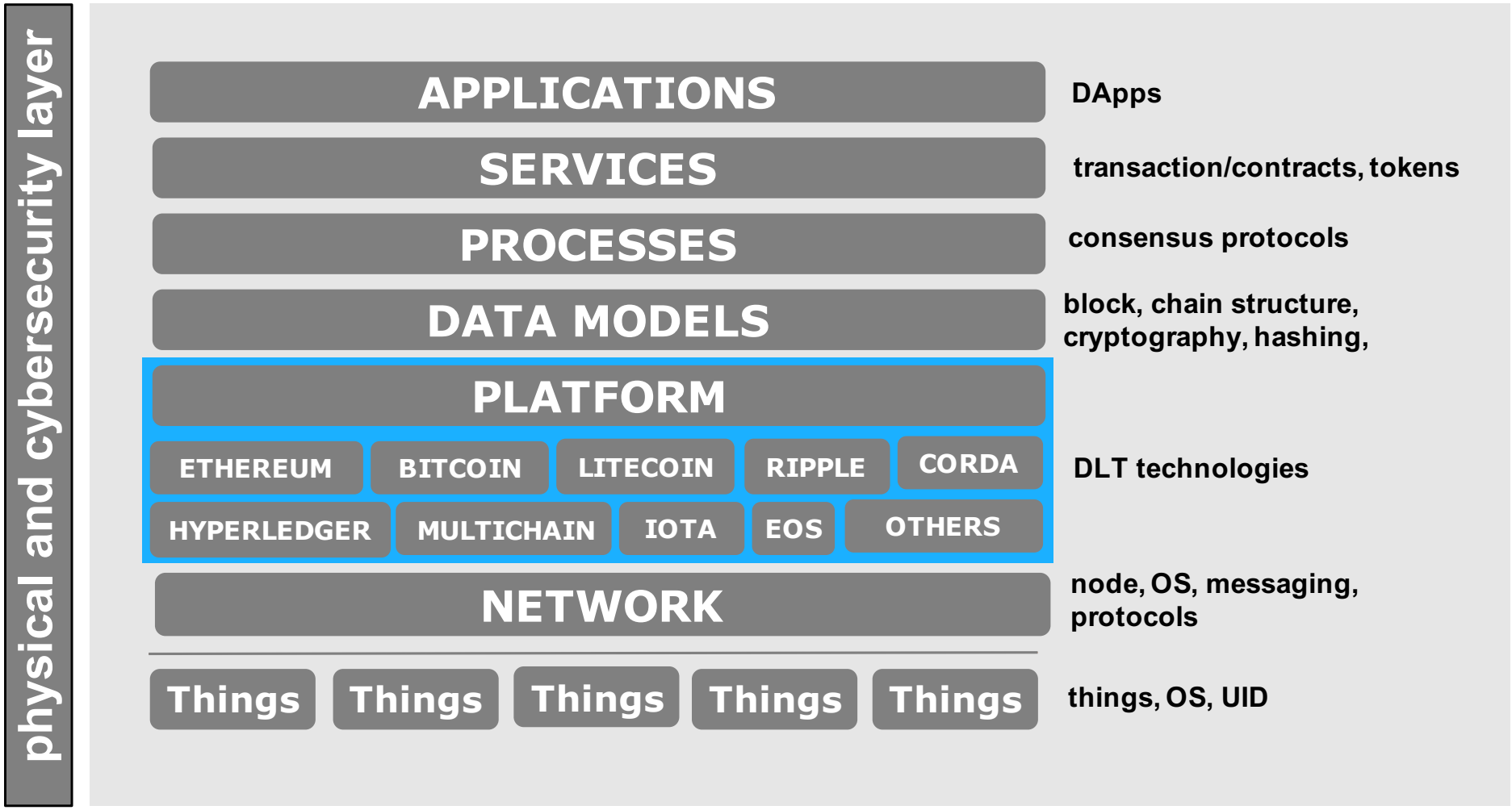
1. Broadest, All Inclusive Architecture (provide alternative paths)
2. Adopts a System Engineering Approach
3. Defines Key Actors and Critical Interfaces
4. Methodological and Well Documented Procedure
5. Top Down Approach (System to Sub-System Level)
6. Secure, Modular, Scalable and Interoperable (use demarcation reference points between ”entities/actors”)
7. Use Technology Neutral Approach
8. Dynamic and Evolving Architecture
9. Covers the Whole Blockchain Engineering Spectrum
10. Useful to all Stakeholders (companies/vendors, SDOs, regulators, etc)
11. Seeks International Adoption and Perspective

3-Steps Standards Development Process



DLT/Blockchain-IoT Reference Architecture

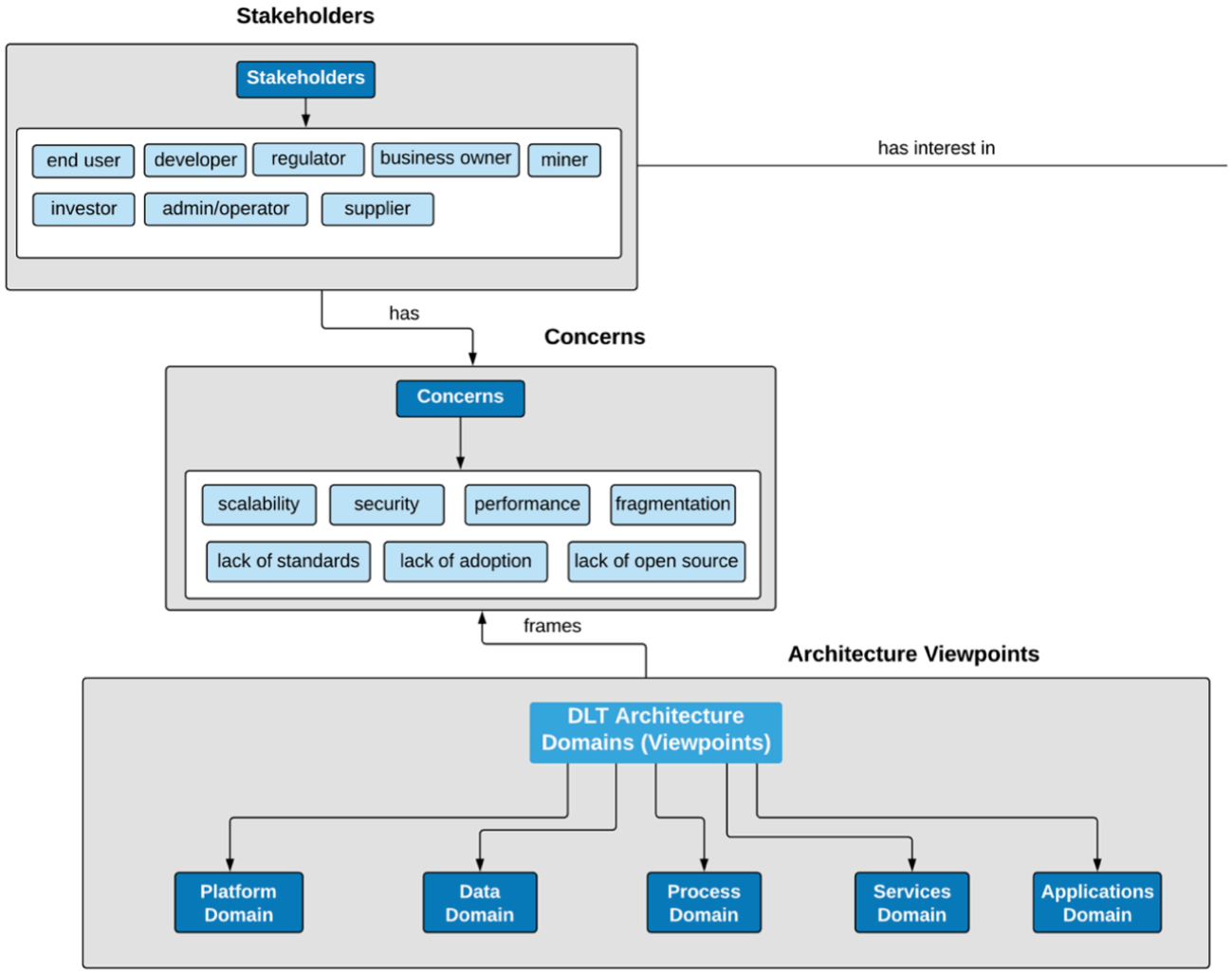
Defining the Key Layers



** BEC contribution to IEEE Blockchain IoT Standards*

DLT/Blockchain-IoT Reference Framework

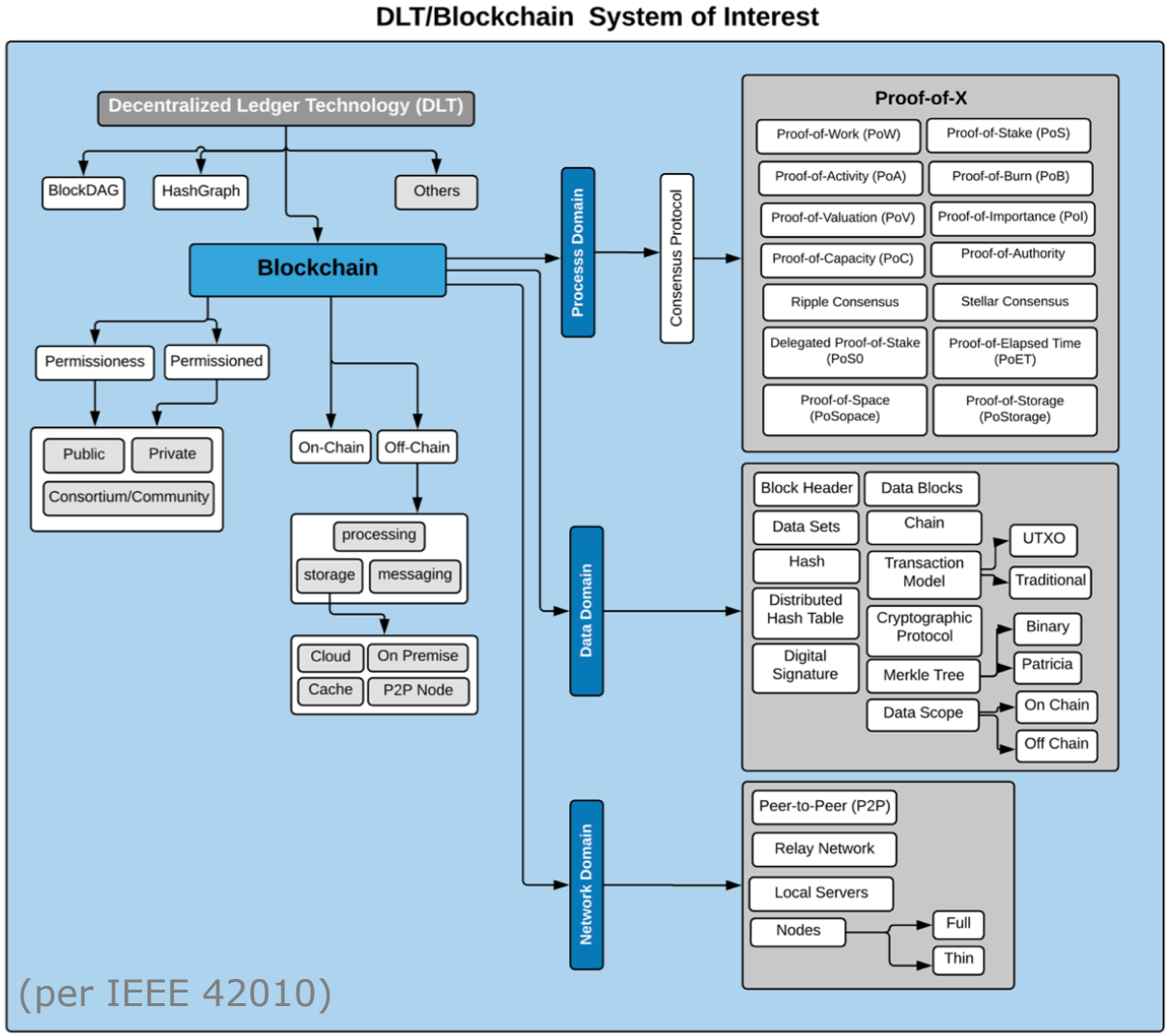
- ✓ Defines key stakeholders
- ✓ Defines concerns of current Blockchain technology
- ✓ Defines architectural viewpoints (layers/domains)



(per IEEE 42010)

DLT/Blockchain-IoT Reference Framework

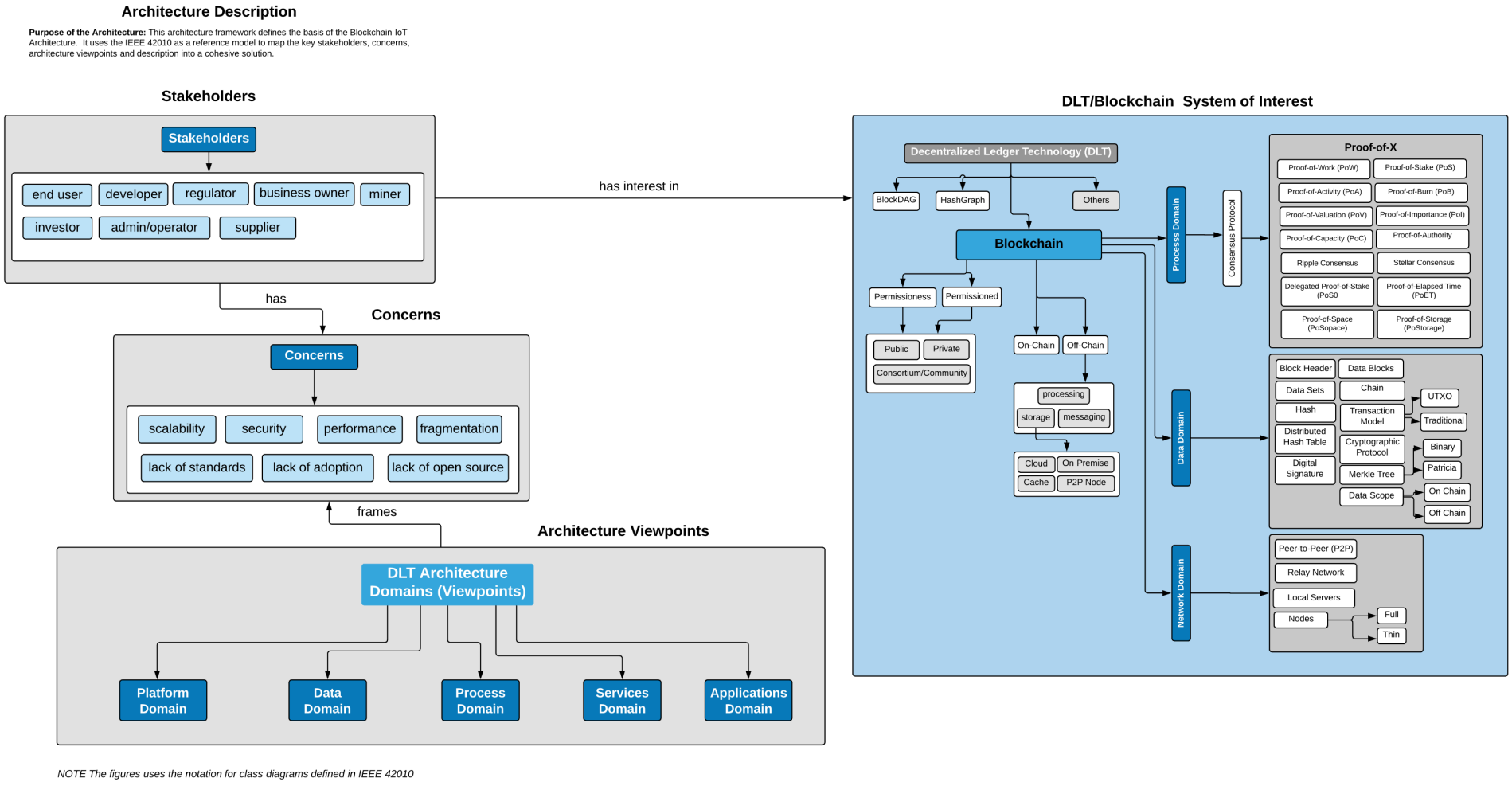
An All inclusive Framework



- ✓ Blockchain-IoT Reference Architecture, based on IEEE 42010 framework (undergoing)
- ✓ All alternatives included - considers more than Blockchain as technology enabler
- ✓ Addresses key domain/layer levels
- ✓ Includes (most) Blockchain/DLT technologies elements

DLT/Blockchain-IoT Reference Architecture

(per IEEE 42010)

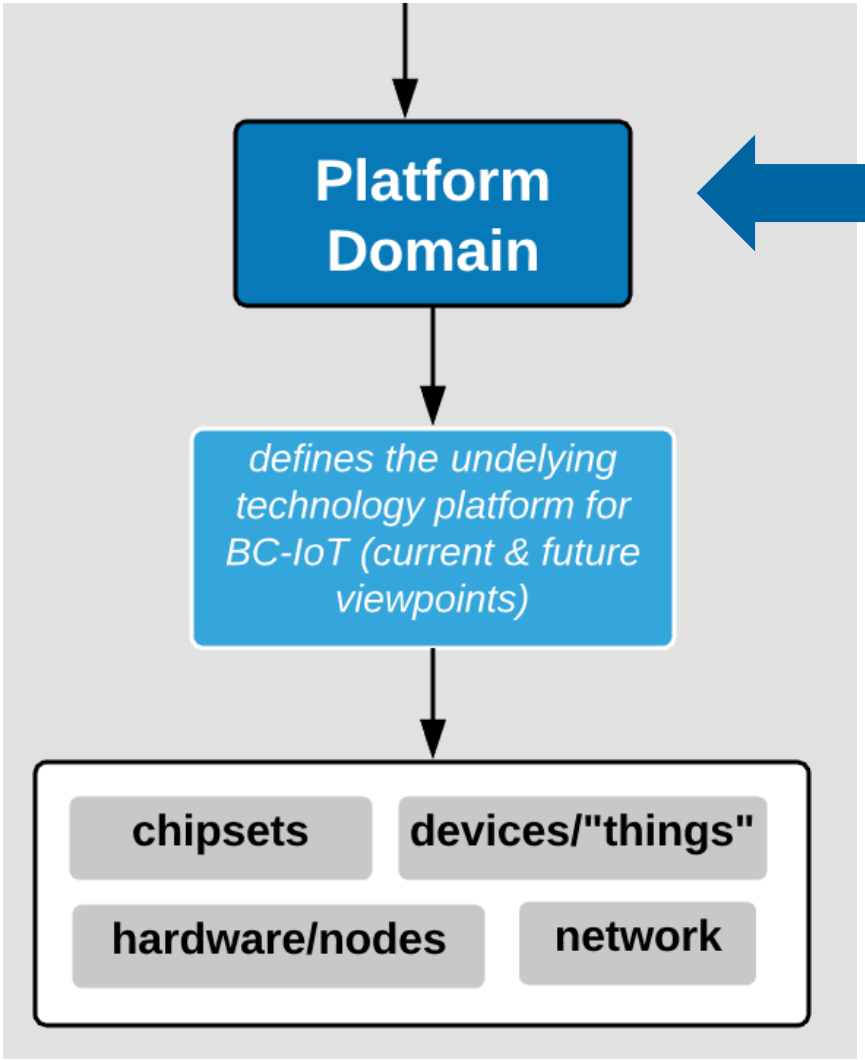


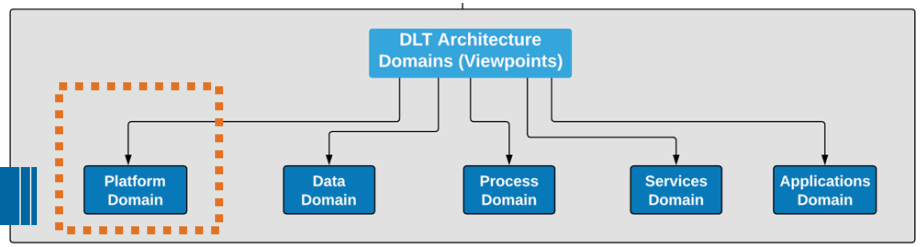
NOTE The figures uses the notation for class diagrams defined in IEEE 42010

source: Blockchain Engineering Council, BEC

DLT/Blockchain IoT Reference Framework

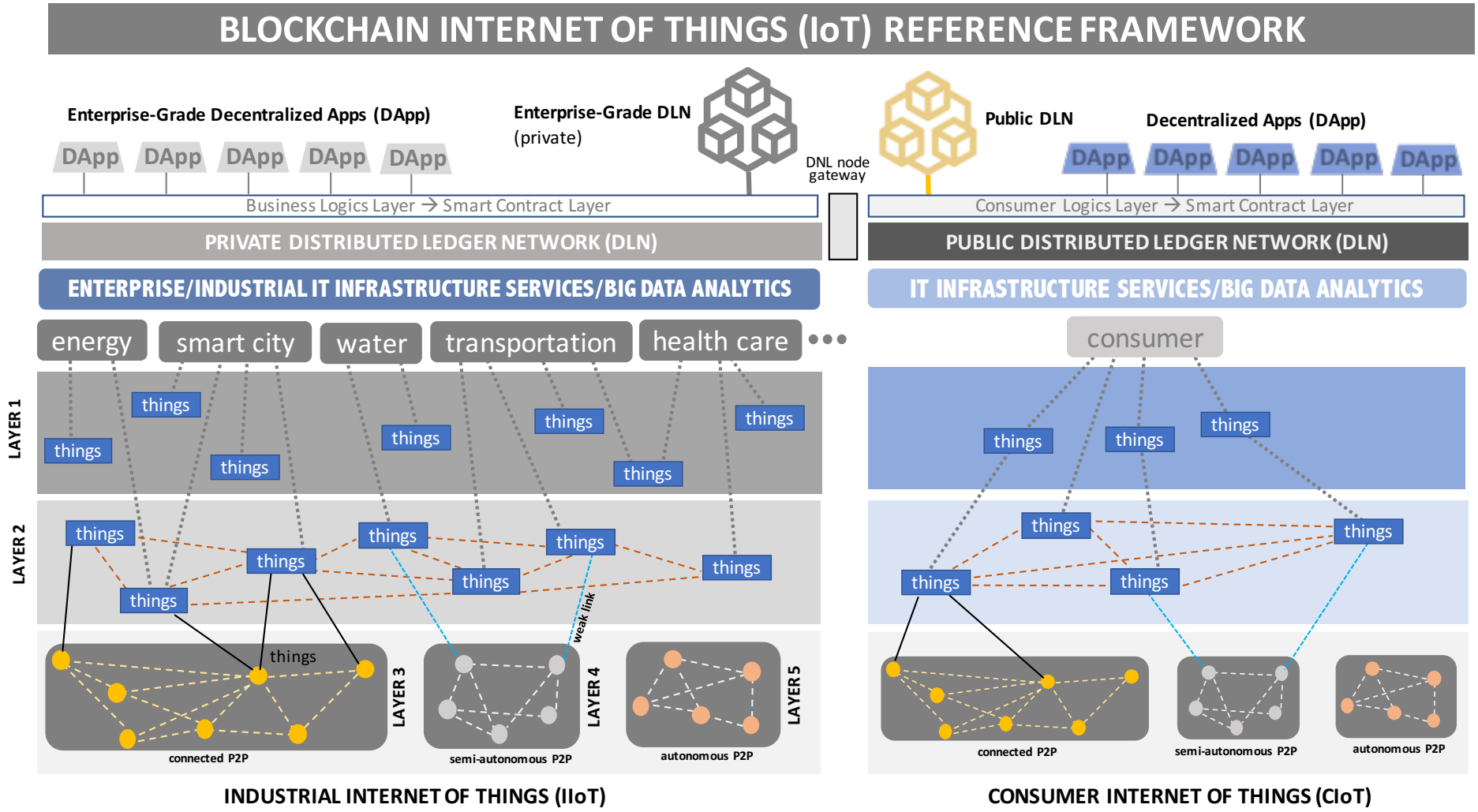
Specific **Platform Domain** (example)





In this Platfom Domain sub-framework IoT entities, such as chipset,hardware/nodes, etc., are considered, where the "**Platform Domain**" is a sub-category of the Blockchain/DLT generic framework

Blockchain Smart City IoT Architecture

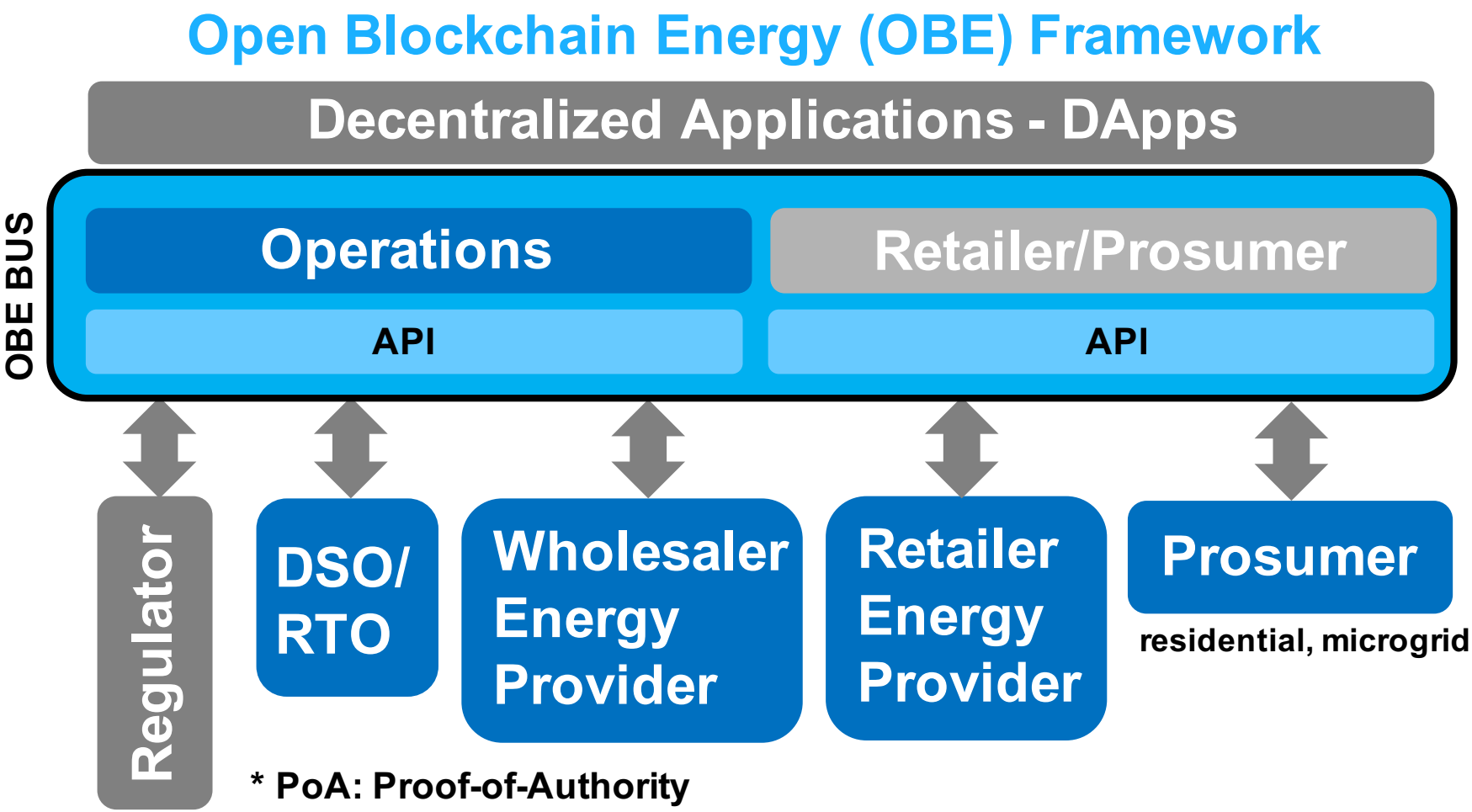


Note: This is not an OSI-Layer format

New IEEE Standards Initiative

Blockchain in Energy

OBE – Open Blockchain Energy (OBE)



source: Blockchain Engineering Council, BEC

OBE – Open Blockchain Energy (OBE)

Key OBE Designing Parameters and Functionalities:

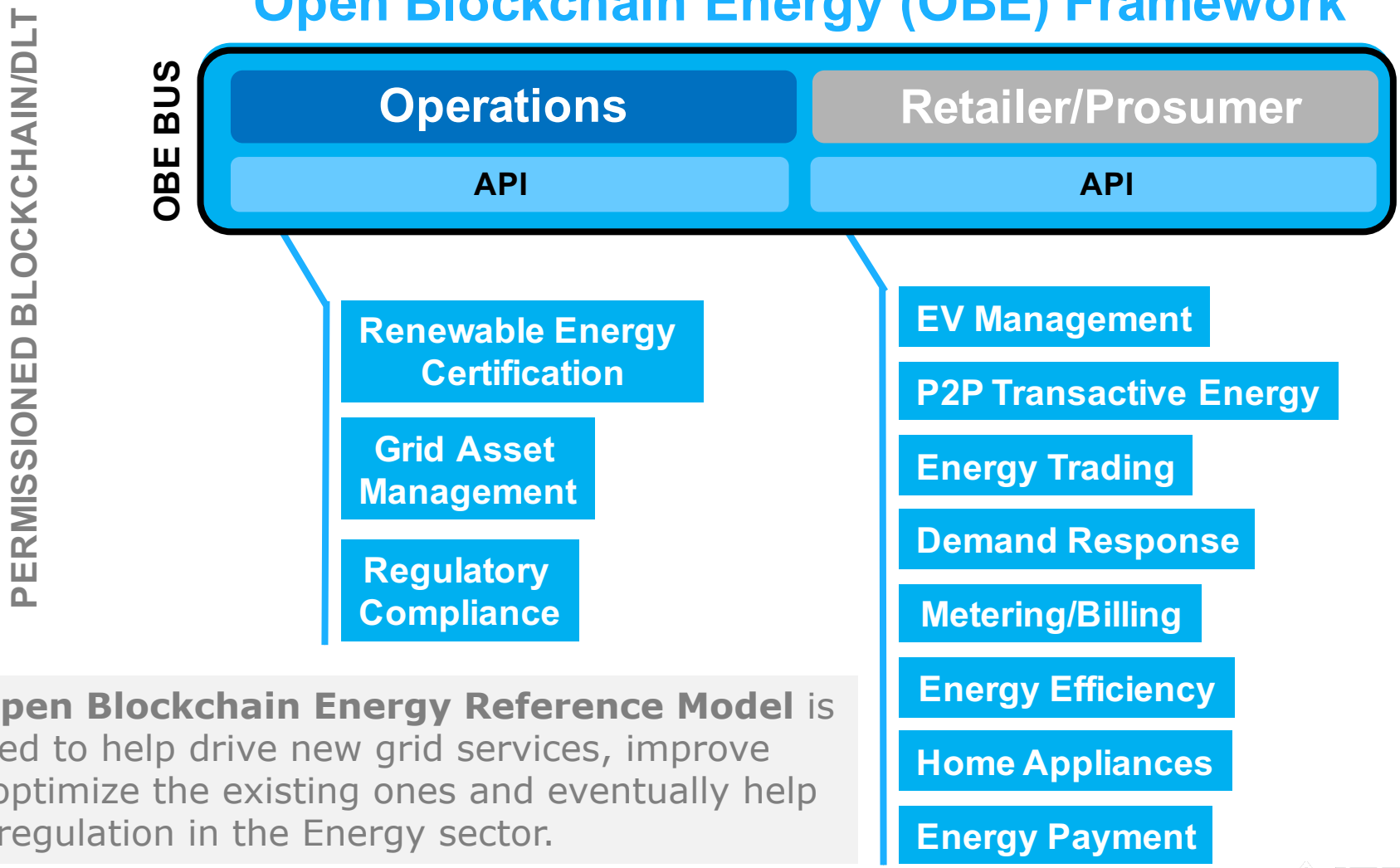
- OBE is **technology agnostic** and creates the DLT/Blockchain Layer where all grid assets and transactions are registered online;
- OBE **segments the wholesale/retail** (operations/prosumer) energy grid and allocates the interface APIs per each grid service segment;
- OBE provides levels of data sub-chain transparency where **privacy, data visualization and control is provided by groups** of interest;
- OBE stores **only machine state, grid transaction and asset registry information**. It does not store sensitive or personally identifiable information(PII) data and is meant to be GDPR compliant;
- OBE registers are authenticated, transparent and trustable

Open Blockchain Energy Framework, focus on open source ledger interfaces for grid infrastructure assets and services

Blockchain in Energy

OBE Application Segmentation

Open Blockchain Energy (OBE) Framework

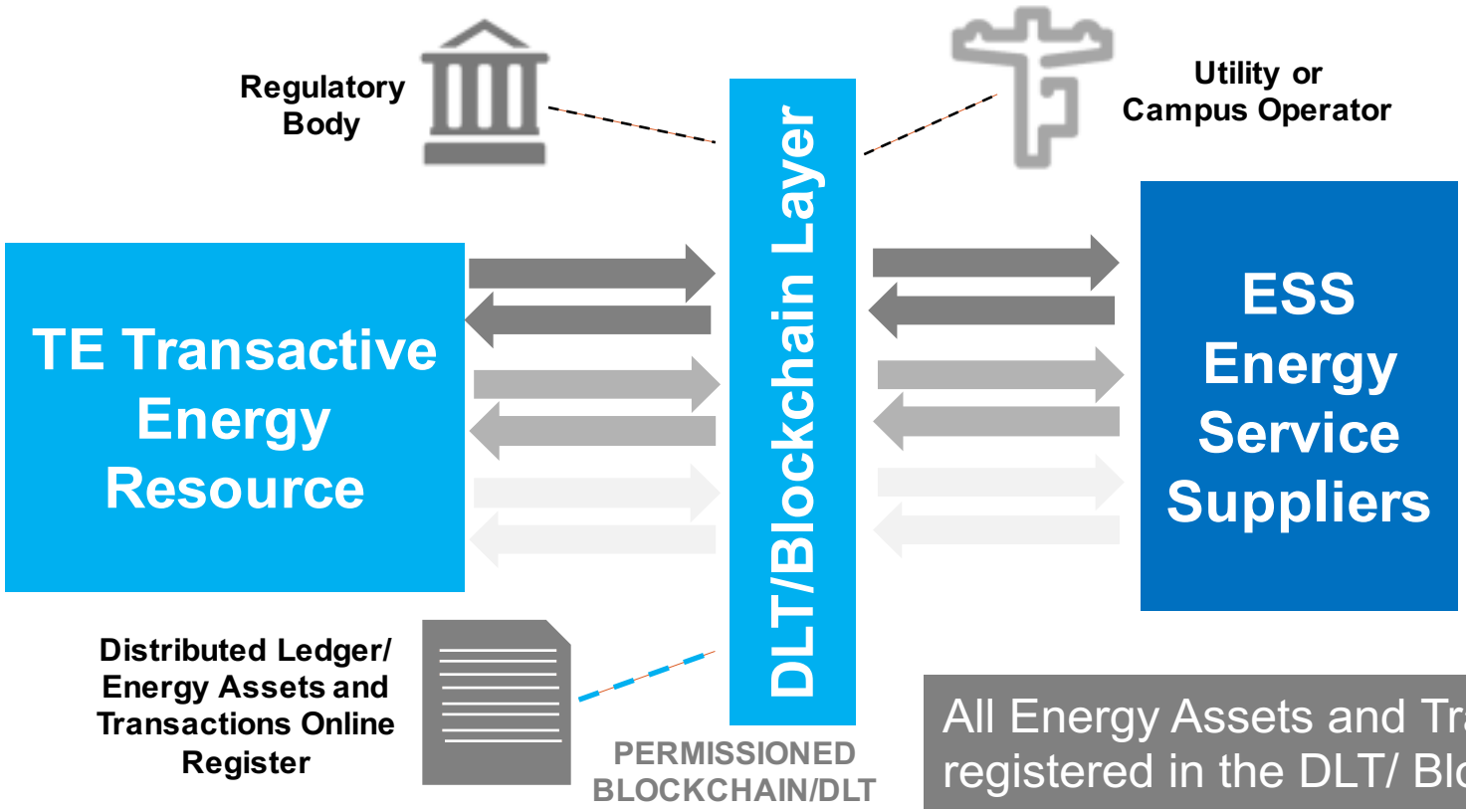


An **Open Blockchain Energy Reference Model** is needed to help drive new grid services, improve and optimize the existing ones and eventually help new regulation in the Energy sector.

source: Blockchain Engineering Council, BEC

Blockchain in Energy

The Role of Blockchain in Transactive Energy



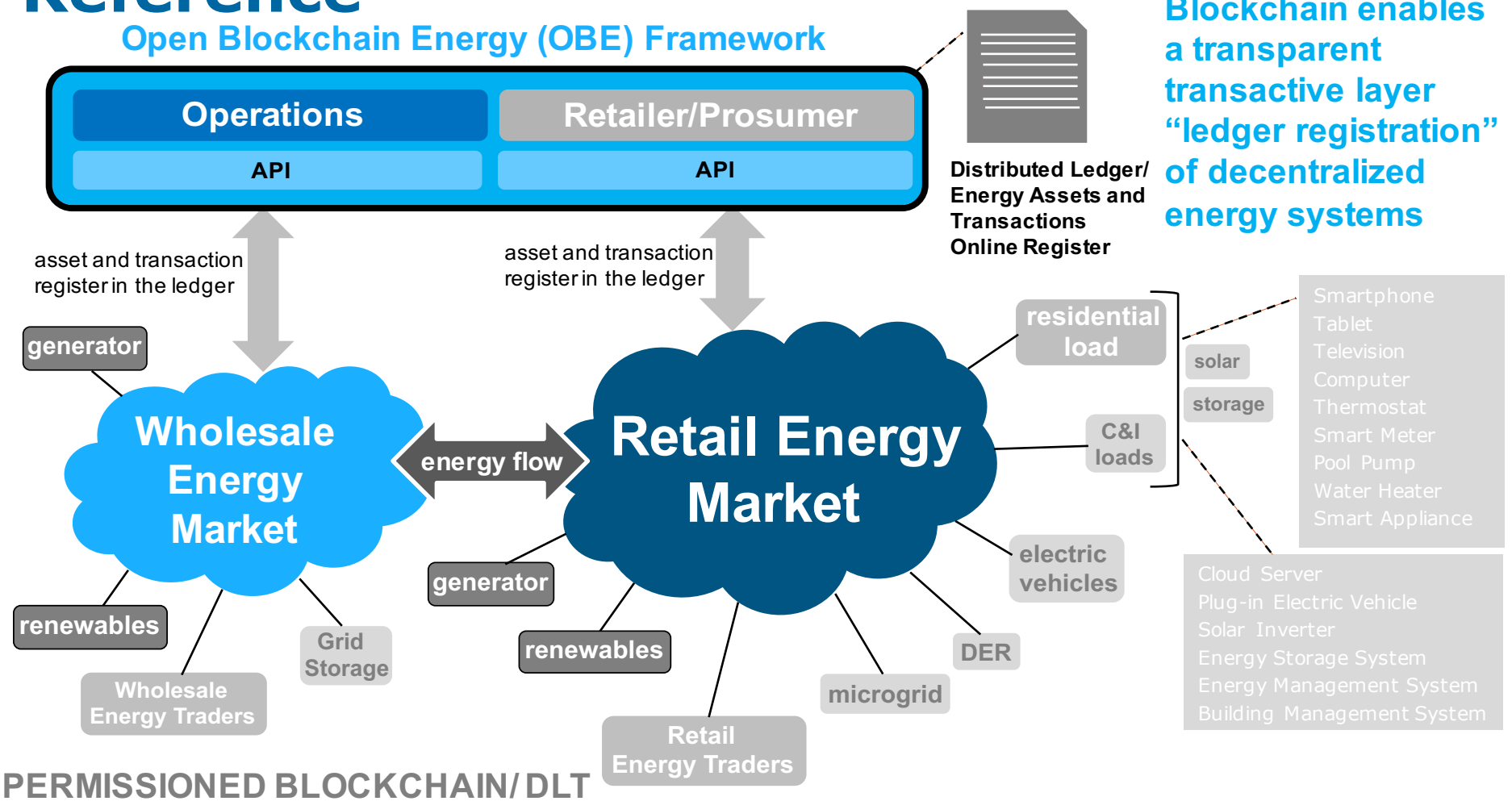
All Energy Assets and Transactions can be registered in the DLT/ Blockchain Layer

Transactive Energy optimizes energy resource allocation with the right supply-demand balance, engaging edge intelligent power grid devices and prosumers (consumer and producer of energy), using market incentive and information exchange grid and economic signals, for control and decisions from generation to distribution and consumption of power.

source: Blockchain Engineering Council, BEC

Blockchain in Energy

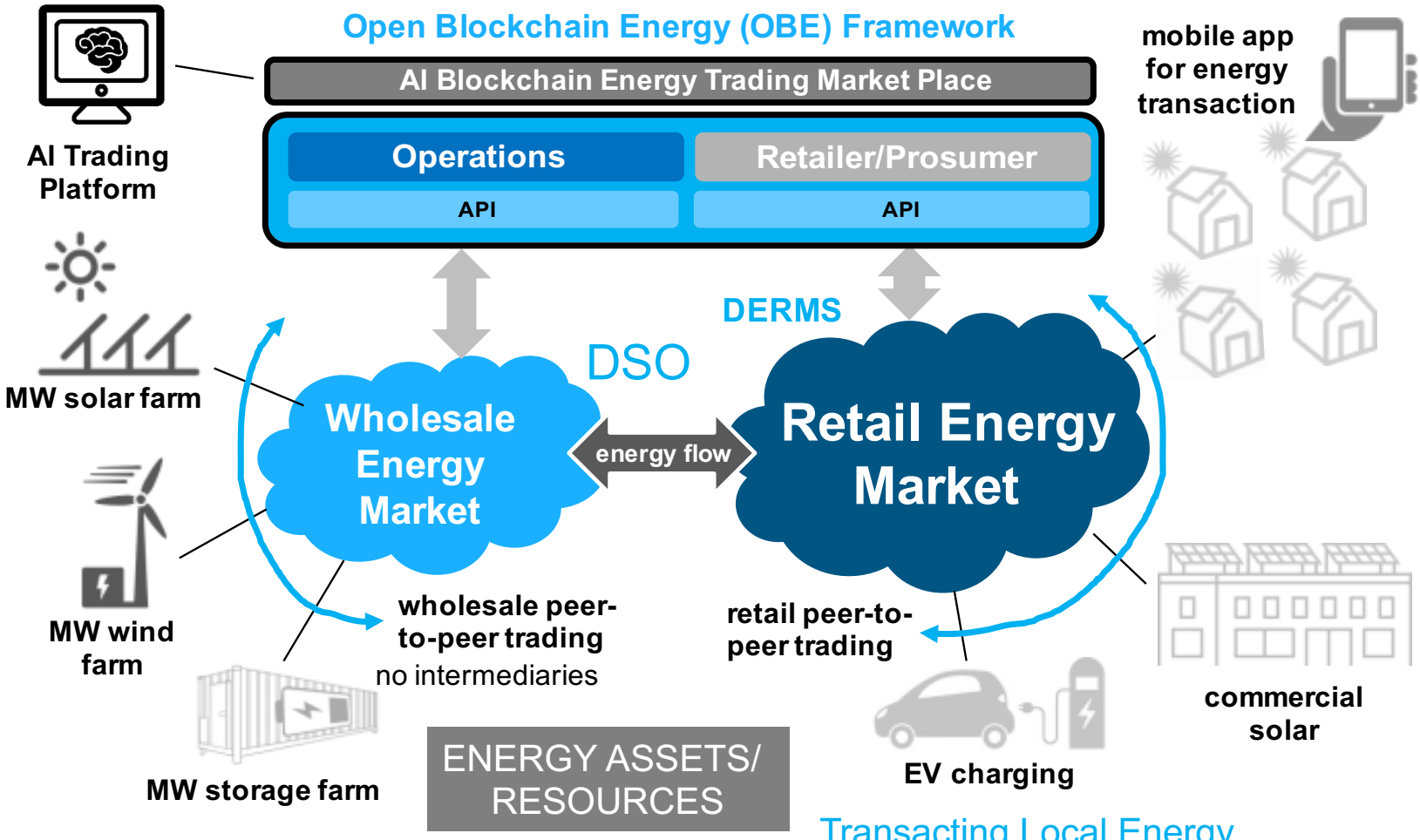
Open Blockchain Transactive Energy Reference



source: Blockchain Engineering Council, BEC

Blockchain in Energy

Peer-to-Peer Wholesale-Retail Blockchain Electricity Trading Model



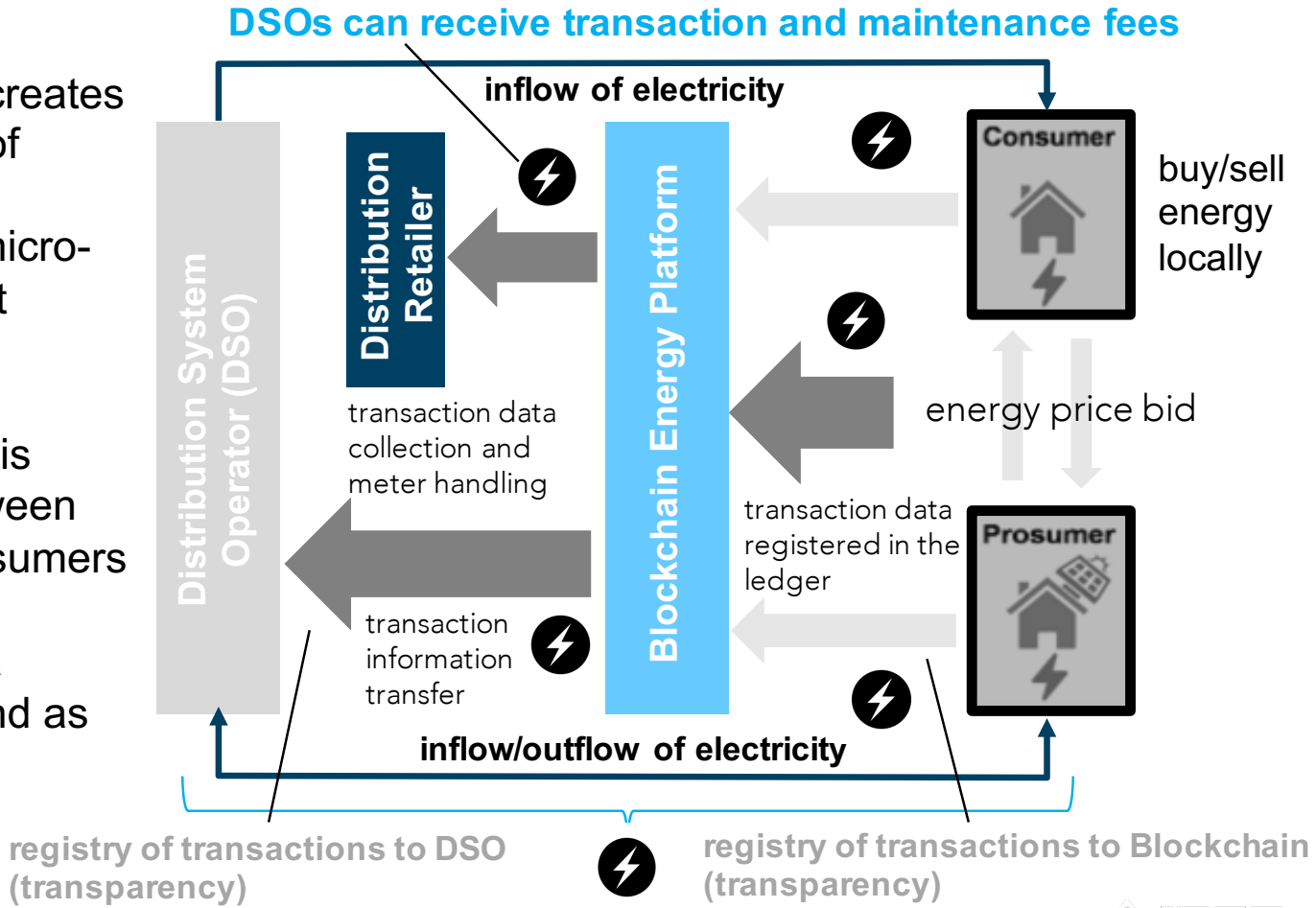
DERMS – Distributed Energy Resource Management System
DSO – Distributed Service Operator

source: Blockchain Engineering Council, BEC

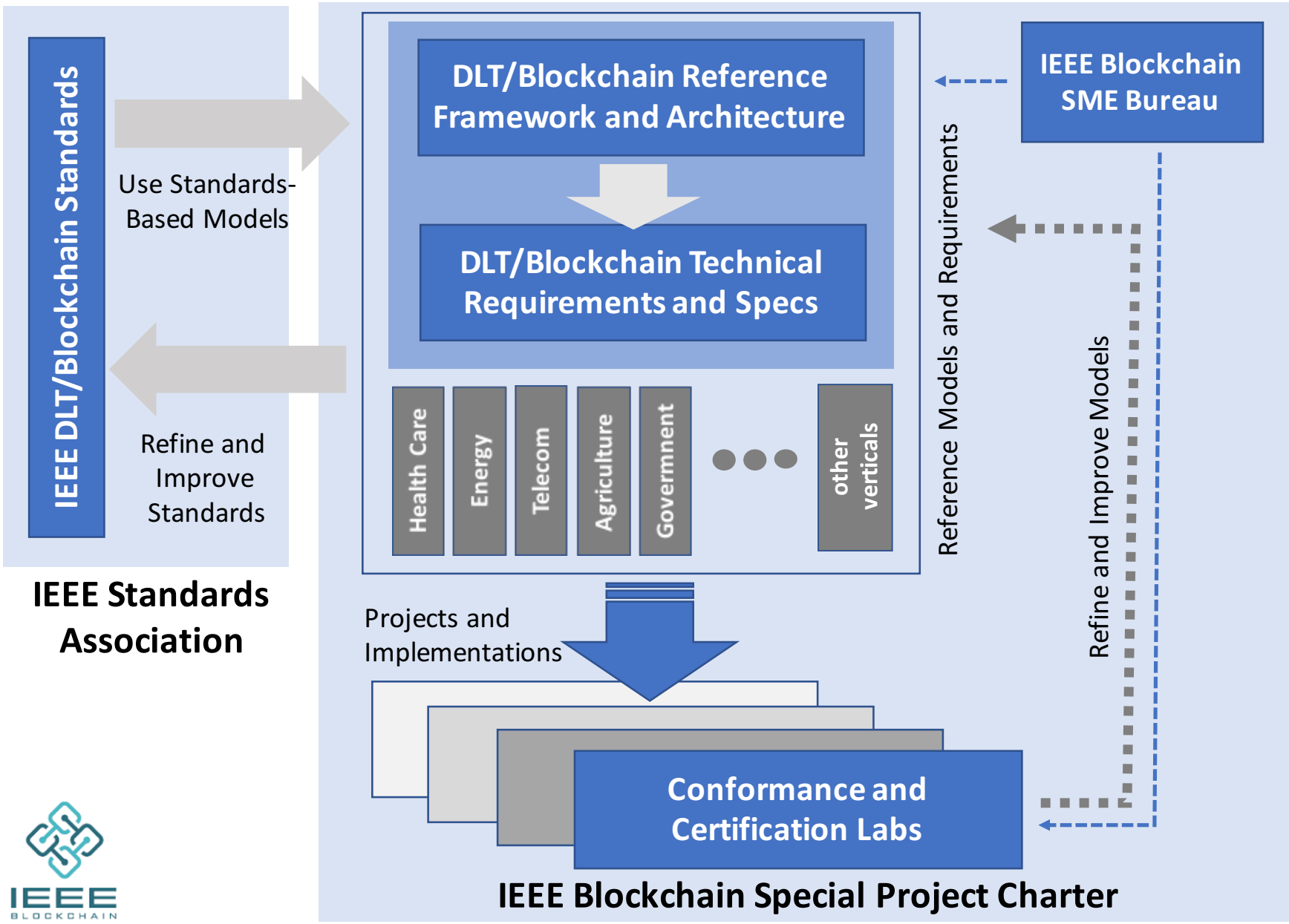
Blockchain in Energy

Peer-to-Peer Electricity Trading using Blockchain as Registry and Payment Layer

- ✓ Neighborhood creates a marketplace of green energy transaction of micro-grid using smart meters.
- ✓ Energy surplus is transacted between consumers/prosumers locally using Blockchain as a registry layer and as payment/token mechanism



IEEE Blockchain Special Projects Framework



DLT/Blockchain Interop Labs

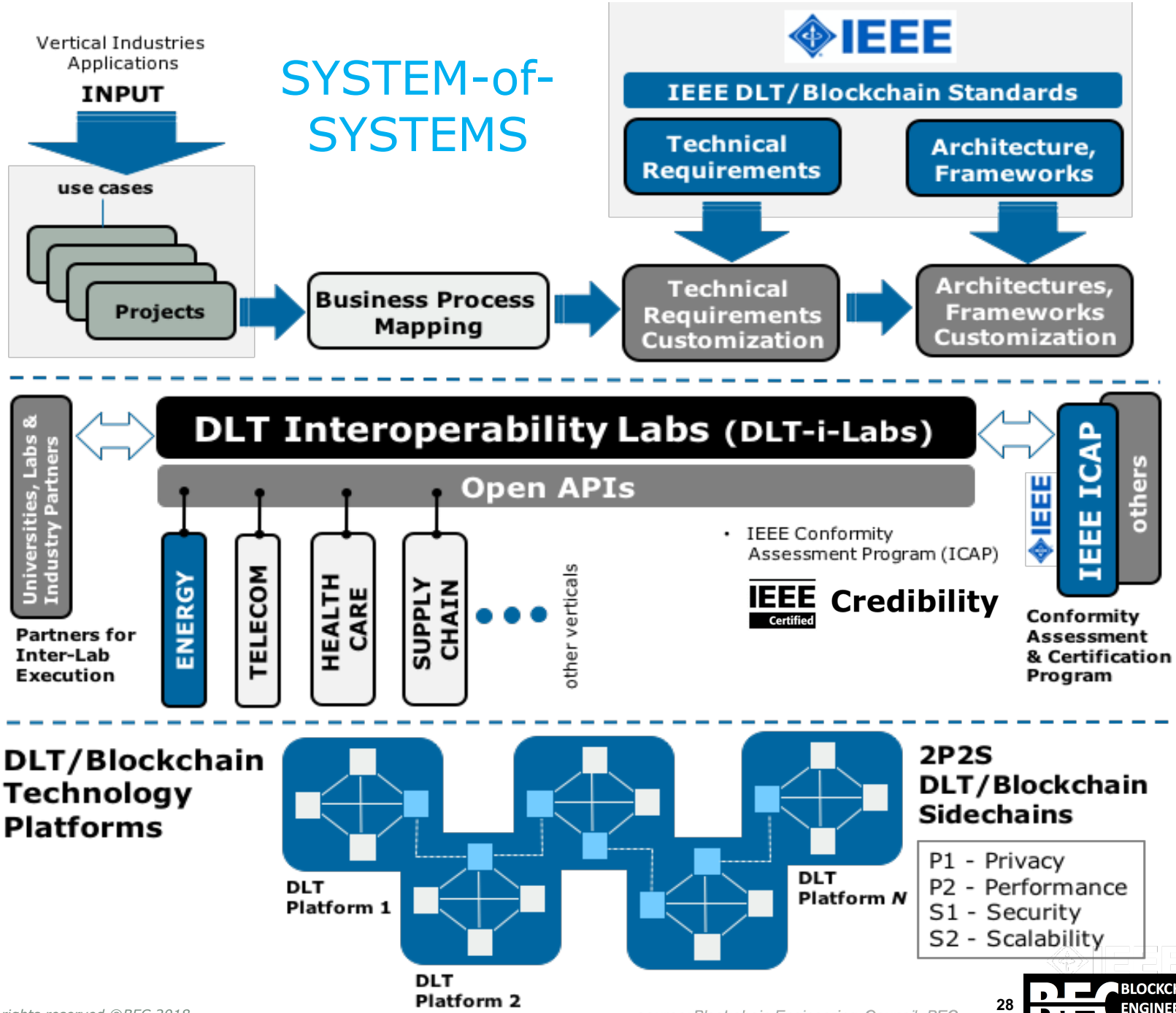
Independent multi-party, open source, open-protocol, technology-agnostic **DLT-Blockchain Interoperability Labs** for Projects, POC-Sandbox and Use Case Validation, based on State-of-the-Art Reference Architectures

2P2S

- validates standards frameworks and requirements
- work with academia and industry partners
- technology agnostic
- modular
- plug-n-play
- customized to vertical application
- seek standards accreditation
- assess security
- assess privacy
- assess performance
- interwork with multiple technology platforms

INTEROPERABILITY STANDARDS

Open Standards, Open Protocol
DLT/Blockchain Interoperability Labs



source: Blockchain Engineering Council, BEC

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Key Takeaways

- The IEEE Standards Association (SA) is developing a set of new **Blockchain/DLT standards** with IoT and vertical market focus;
- The initial work is to create generic, technology agnostic and open source Blockchain/DLT reference models and frameworks to put all standards development into context;
- Industry-specific (e.g. energy, health care and others) and technology driven (e.g. data formats) IEEE Blockchain standards will benefit from these generic frameworks;
- IoT in Blockchain is addressed by these IEEE standards and requires a high level of interaction with other standards due to its complex nature;
- **2P2S Enterprise-Grade Inter-Chain Sidechains are important for the evolution of Next Gen Decentralized Internet**

This work will serve as a guide to build other standards

THANK YOU!

CONTACT

For any inquiries, please contact us at:
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